

10/507062

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Fuel Additive Characteristics of Ester Oxygenates  
Made by the Process of the Invention -  
Comparative Data

Fuel Additive Characteristic	O <sub>2</sub> Content (wt %)	Content in Oxygenated Gasoline (wt %)	Content in Oxygenated Gasoline (wt %)	Vapor Pressure at 100°F (kPa)	Blending Octane No. (R+M)/2
Additive Name		2.7 wt% O <sub>2</sub> Requirement	2.0 wt% O <sub>2</sub> Requirement	[1]	AS Reported
MTBE	18	11	14.9	55	109[2]
Methyl Formate	53	3.8	5.1	126.2	101.5[3]
Ethyl Formate	43	4.6	6.3	55	102.5[3]
N-Propyl Formate	36	5.5	7.4	19.9	
Isopropyl Formate	36	5.5	7.4		
N-Butyl Formate	31	6.4	8.6	7.4	
Isobutyl Formate	31	6.4	8.6	10.2	
Sec-Butyl Formate	31	6.4	8.6	12.1	
Tert-Butyl Formate	31	6.4	8.6	19.8	
Amyl Formate Ester	28	7.3	9.8	2.5	

FIG. 1A

Fuel Additive Characteristics of Ester Oxygenates  
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Comparative Data

Fuel Additive Characteristic	O <sub>2</sub> Content (wt %)	Content in Oxygenated Gasoline (wt %)	Content in Oxygenated Gasoline (wt %)	Vapor Pressure at 100°F (kPa)	Blending Octane No. (R+M)/2
Additive Name		2.7 wt% O <sub>2</sub> Requirement	2.0 wt% O <sub>2</sub> Requirement	[1]	As Reported
Methyl Levulinate	37	5.4	7.3		106.5 [3]
Ethyl Levulinate	33	6.6	8.1		107.5 [3]
N-Propyl Levulinate	30	6.6	8.9		
Isopropyl Levulinate	30	6.6	8.9		105 [3]
N-Butyl Levulinate	28	7.2	9.7		
Isobutyl Levulinate	28	7.2	9.7		102.5 [3]
Sec-butyl Levulinate	28	7.2	9.7		102.5 [3]
Tert-Butyl Levulinate	28	7.2	9.7		
Amyl Levulinate	26	7.8	10.5		
Isocamyl Levulinate	26	7.8	10.5		

FIG. 1B